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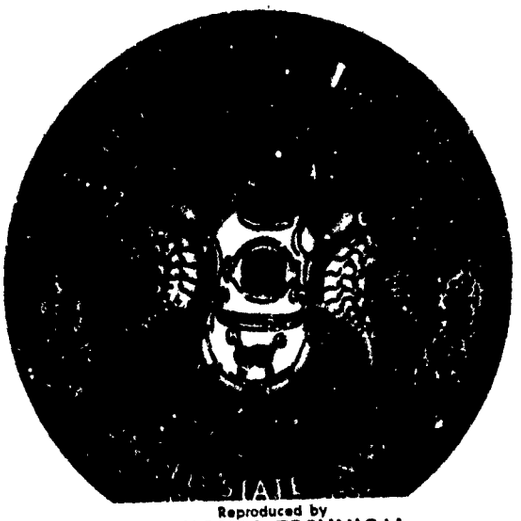

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TEST OF RECIRCULATION AND JET FLOW OF HeO_2 HELMETS FROM USS TRINGA AND USS PETREL

11 MARCH 1948

11 March 1948

U. S. NAVY EXPERIMENTAL DIVING UNIT

NAVAL GUN FACTORY

WASHINGTON, D. C.

Project No. - SRD-235-46

Title - Test of Recirculation and Jet Flow of HeO_2 Helmets from USS TRINGA and USS PETREL

G. G. MOLUMPHY
Commander, USN
Officer in Charge

OBJECT

The object of this test is to evaluate the recirculation and the jet flows of the HeO_2 helmets submitted by the USS TRINGA and the USS PETREL.

METHOD

All tests were made under atmospheric pressure. The helmets were tested just as received. The nozzles and jets were not cleaned or readjusted in any manner except in the case of the jet flow of oxygen. Here a number 74 drill was passed through the jet to determine its effect on the jet flow. Tests made on both helmets were identical. The cannisters were empty. Two methods of measuring total recirculation were used.

Air was used in all tests except in the determination of jet flow before and after passing of the number 74 drill. Oxygen was used in these cases.

The following procedure was used in the total recirculation tests: The pressure over bottom was varied from 25 lbs/in^2 to 100 lbs/in^2 in 25 lbs/in^2 increments. The recirculation was measured by leading the hose from the discharge duct of the helmet into a spiremeter. This hose was 3/4 inch inside diameter and was approximately 8 feet long. The end connected to the helmet was fitted with a nipple which in turn was fitted to a soft sponge gasket. This was held against the discharge duct manually when a recirculation flow reading was desired. Readings of the spirometer were made before and after definite intervals, determined by a stop watch. The spirometer's identification number was 000200.

The other recirculation test followed the same procedure except that the cannister was removed and the hose was placed over the Venturi tube.

The jet flows were made by removing the venturi tube and placing a 3/16 inch inside diameter hose over the jet discharge. This flow was exhausted into the spirometer as before. Air was used.

The jet flow was again taken with oxygen. A small hose was placed over the discharge jet as before and discharged into a Sargent wet test meter. The jet orifice was then reamed out with a number 74 drill, and the flow again was taken in the same manner. The meter identification number was 000250.

All flows are given in liters per minute except when indicated otherwise.

DISCUSSION OF RESULTS

The recirculation of both helmets compares favorably with recirculation flow tests of other HeO_2 helmets in good condition at the U.S. Navy Experimental Diving Unit. In fact, the total recirculation is slightly higher. Air was used in these recirculation tests. This was expedient because the use of a HeO_2 mixture would necessitate a closed circuit and hence a more complex apparatus set up. The use of air as the gas is reliable since parallel experiments were made with both gases up to a depth of 225 feet. Therefore the results of air experiments can be translated into terms of the HeO_2 mixture. From the total recirculation data obtained, it can be said that the total recirculation is comparable to that of a HeO_2 helmet in good working order. The total recirculation of both helmets tested was about identical at 50 lbs/in^2 over bottom pressure being supplied to the Venturi.

Attention is invited to the two methods of obtaining recirculation flows. There is considerably more recirculation when the flow is measured with the cannister removed and the hose placed over the Venturi tube. This is to be expected since the turbulence and friction encountered in the passage of gas through the cannister is eliminated. In these experiments, the cannister was empty. With Shell Natron, the effect of this friction and turbulence would be accentulated.

In previous experiments it was found that the placing of Shell Natron in the cannister reduced the recirculation flow about 10% when air was used at atmospheric pressure. The same hose was used to the spirometer in both tests, and the friction loss due to this cause would be about the same. In view of the above, it would be reasonable to assume that the actual recirculation is somewhere between these two recirculation flows.

The jet flow of the helmet from the USS TRINGA was 0.447 ft^3 of oxygen per minute with 50 lbs/in^2 over bottom pressure supplied to the jet. This rate falls into the upper part of the normal range of 0.40 to 0.45 ft^3/min. After a number 74 drill was passed through the jet, the flow did not change appreciably. The slight change is probably due to normal experimental error. The jet opening seemed to be free and the drill passed through easily.

The jet flow of the helmet from the USS PETREL was 0.341 ft^3 of oxygen per minute with 50 lbs/in^2 over bottom pressure. This is somewhat below the normal range of jet flows. After the jet was reamed out with a number 74 drill, a flow of 0.415 ft^3/min was obtained. It was evident that the jet crifice was undersize or partially plugged. The former was more probable since some metal chips were produced in the reaming process.

If the jet and recirculation flows are normal at these conditions, it can be assumed that they will be satisfactory at various depths. The ratio of recirculation to jet flow as proven by previous experiments is about seven or eight to one over a wide range of depths. This ratio increases somewhat with depth. It is applicable to a jet position of flush to 1/4 inch away with respect to the mouth of the Venturi tube. This variation in jet positioning is due to the difference face to face dimensions of the casting receiving the jet and the Venturi tube. The jet positioning affects the recirculation flow at atmospheric pressure. However, at depths past 150 feet, the difference is negligible.

It must be emphasized that the jet delivery of oxygen at a rate of 0.40 ft^3 to 0.45 ft^3/min at atmospheric pressure will deliver but about 0.25 ft^3/min of HeO_2 mixture, 19.5% O_2, at a depth of 225 feet. The total recirculation would be about eight times this value or approximately 2 ft^3/min.

The Venturi tube of the USS TRINGA was in fairly good shape with a slight dent at the discharge edge. The one from the USS PETREL was in fair shape with some slight dents at the discharge edge. The effect of these dents on the recirculation is probably not of great importance.

Since both castings were about 2 1/16 inches face to face, the jet would be about 1/16 inch from the Venturi tube mouth. This falls within the accepted range.

CONCLUSIONS AND RECOMMENDATIONS

The total recirculation of both helmets is comparable to other HeO_2 helmets in good condition.

The jet flow of the helmet from the USS PETREL was somewhat below the normal range of 0.40 to 0.45 ft^3 of oxygen per minute at atmospheric pressure. Reaming the jet crifice brought the flow within a normal range. The jet crifice was either undersize or had an obstruction. The metal chips pointed to the former.

It is recommended that a number 74 drill be passed through the jet crifice each time a helmet is used, in accordance with the instructions contained in paragraph 5, page 227, Bureau of Ships Diving Manual, 1943.

Jet flow can be used as a criterion of total recirculation since the ratio is about seven or eight to one over a large range of depths. This is based on the assumption that the entire system is in good working order under normal conditions.

Air can be used as a fairly good check of recirculation performance in the HeO_2 helmet.

DATA SHEET

Helmet from the USS TRINGA (orange). The Venturi tube was in fairly good shape with a small dent at the discharge edge. The face to face dimension of the casting receiving the Venturi and jet is 2 1/16 inches. Air used except when noted otherwise. All flows in liters per minute except as noted. #3056 was manufactured by the Diving and Equipment and Salvage Co., Milwaukee, Wisconsin.

Pressure over bottom #/in^2	25	50	75	100
Recir. with hose led from discharge duct in helmet - 1/min.	75.5	94	113	124
Recir. with hose over Venturi with cannister removed - 1/min.	92	115	138	158
Jet flow (air) - 1/min.	6.5	12	17.5	22.9
Jet flow (O_2) - 1/min. F^3/min.	7.85 0.277	12.7 0.447		
Jet flow (O_2) after passing #74 drill - 1/min. F^3/min. Drill went through easily	7.95 0.280	12.6 0.445		

Helmet from the USS PETREL (yellow). Face to face dimension of casting is 2 1/16 inches. Venturi in fair shape with some slight dents at edges.

Pressure over bottom #/in^2	25	50	75	100
Recir. with hose led from discharge duct in helmet - 1/min.	70	97	123	142
Recir. with hose over Venturi with cannister removed - 1/min.	82	115	148	178
Jet flow (air) - 1/min.	4.85	8.8	11.9	17.1
Jet flow (O_2) - 1/min - F^3/min	5.9 0.209	9.65 0.341		
Jet flow (O_2) after #74 drill was passed. Drill went in with difficulty and some drilling had to be done before drill entered freely - 1/min - F^3/min	7.27 0.257	11.7 0.415		